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ABSTRACT

This paper discusses some psycholinguistic and psychological bases of learning to read in two apparently disparate writing systems, English and Chinese. As an alphabet, English orthography has "more reason than rhyme"; relational units and markers (e.g., "hens" and "hence") are important. The combinatory properties of radicals and phonetics in Chinese logographs are parallel to morphophonemics in English. In both systems, linguistic segmentation and understanding of rules as applied to syllables or characters, to words, and to sentences are particularly important to initial reading. The mapping from orthographic representations to meaning, whether phonologically mediated, differs in the writing systems. Luria's claim of differential cortical processing for different languages finds some support from clinical studies and provides a clue to understanding learning to read in diverse orthographies. (Author/AA)

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Abstract

Learning to Read in English and Chinese -- Some Psycholinguistic and Cognitive Considerations

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This paper discusses some psycholinguistic and psychological bases of learning to read in two apparently disparate writing systems -- English and Chinese. As an alphabet the English orthography has "more reason than rhyme"; relational units and markers (e.g. "hens" and "hence") are important. The present writer will show from his studies the combinatory properties of radicals and phonetics in Chinese logographs as parallel to morphophonemics in English. In both systems linguistic segmentation and understanding of rules as applied to syllables or characters, to words and to sentences are particularly important to initial reading. The mapping from orthographic representations to meaning, whether phonologically mediated, differs in the writing systems. Luria's claim of differential cortical processing for different languages finds some support from clinical studies and provides a clue to understanding learning to read, or not to read, in diverse orthographies.

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Learning to Read in English and Chinese --

Some Psycholinguistic and Cognitive Considerations

" 'Did you say pig or fig?' said the cat. 'I said pig,' replied Alice." That short exchange from Carroll's Alice's Adventures in Wonderland illustrates some of the pre-requisites in learning to read in English. Alice had to consider the contrastive patterns of stop and continuant consonants in choosing the former while rejecting the latter. In the same speech segment she also used the gravity and tenseness of /p/ as distinct from the acuteness of /t/ and the laxness of /b/. All these attributes were combined into a bundle of distinctive features (phonemes). The phoneme /p/ was followed by phonemes /i/ and /g/, themselves bundles of simultaneously produced distinctive features. Hence to discriminate between "pig" and "fig" Alice had to discern and differentiate between the concurrence of simultaneous entities and the concatenation of successive entities - differentiations important in the learning to read process in English.

As learning to read in English builds on the speech processes of the child, it is largely learning by eye and by ear (see Kavanagh, 1968; Kavanagh and Mattingly, 1972). Similarly, it is not an oversimplification to say that learning to read in such a disparate writing system as Chinese is largely learning by eye and by hand. Figure 1 illustrates specimen Chinese characters and words. The

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Insert Figure 1 about here

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character 中 meaning "centre", combined with another character 間 gives the equivalent word "middle". The character 醫 (medicine, to cure) has three components meaning: (a) wound enclosing [an arrow 矢 (匸); (b) extracting foreign bodies with an instrument 殳 and (c) treating wound with tincture 酉 which is a variant of wine 酒 (tincture diluted with water 氵). The character 毉 in combination with 生 (to give birth or to grow) means a healer, a physician. The illustration of the number and direction of strokes shows the balance and flow of each character - attributes to be mastered by hand. It is therefore no surprise that beginning readers in Chinese start learning to write early - and plenty of writing as well. This spaced and massed practice capitalizing on the eye-hand "linguistic awareness" of the language must help the learning to read process in Chinese.

All beginning reading is largely the mapping of the encipherment in script, be it English or Chinese, on to some underlying "lexical representation" and meaning. Models of learning to read, particularly of word identification, almost all emphasize reading as an active, analytical and synthetical process (see Gibson, 1970a, 1970b; Gibson and Levin, 1975). This involves high-speed visual scanning of graphic symbols, analysis of critical features from clusters of letters to progressively higher order units of structure, evocation of some inner thought and the understanding of syntactical relationships.

Within this framework, some researchers (Huey, 1908; Mattingly, 1972; Shankweiler and Liberman, 1972, in press) have stressed the importance of the phonological representation of beginning reading in an alphabetic system. It is likely that an ideographic system like Chinese will make contact with the inner "lexical representation" more at the morphological and less at the phonetic base. It is the aim of this paper to explore further similarities and differences of the psycho-linguistic and psychological processes underlying initial reading in English and Chinese.

Overview of English and Chinese as Symbol Systems

It is generally agreed that the English orthography with 26 letters of the alphabet and some 46 phonemes is a more efficient system for information processing. Uncertainty amongst 26 alternatives of the alphabet as given by - log 1/n (or - log 1/2 with two alternatives) is 4.7 bits of information if each letter is regarded as equi-probable, and 4.03 bits if the distributional redundancy is considered (Shannon, 1951). If to the 26 letters are added comma, period, space and a few other punctuation marks, then the information given by any one of the symbols is about 32 (2^5) or 5 bits. There are, however, more than 26 or 32 functional units which are critical to reading. One of the tasks the beginning reader has to do is to identify clusters of letters or letter groups, which number some 65 graphemic units according to Venezky (1967) in his analysis of a 20,000 word corpus. He explains that these spelling or graphemic units "are not related directly to

sound, but to an intermediate (morphophonemic) level first and then to sound" (p.84). Morphophonemic rules are a complex set of relationships between orthographic symbols and the phonological system of speech. Certain clusters of letters, and hence phonemes are possible according to these rules but do not actually occur (e.g. "sklig"). On the other hand, the reader should be aware, implicitly or explicitly, that in "mis'hap" the sh does not form a cluster as the two letters are separated by a morphemic boundary (Venezky, 1967, p. 84). Similarly, ch is realized as [č] in "chief", as [š] in "chef", or as [k] in "echo". (Venezky, 1970, p.36). "Knowing" these phonological rules will reduce uncertainty (in the information sense) on the part of the reader and will help him in his reading.

In contrast, Chinese is a good example of ideographic or morphemic writing in which each symbol, usually referred to as a character, represents a morpheme. The language is best described as monosyllabic, isolating (compared with inflexional languages) and analytical (with few bound forms) (see Karlgren, 1962; Leong, 1973). Estimate of the minimum number of characters to be mastered as adequate for practical purposes is from 3,500 characters (Leong, 1972, 1973) to between 4,000 and 7,000 characters (Wang, 1973). Assuming a newspaper uses between 4096 (i.e. 2^{12}) and 8192 (i.e. 2^{13}) characters, a single character thus gives between 12 and 13 bits of information. This increase in information value compared with the 4 or 5 bits carried by letters of the English alphabet is achieved at the expense of the memory load

required. It must also be borne in mind that the basis of a word in Chinese is a combination of two or more characters. The permutation and combination of, say, 4000 characters usually within the repertoire of a grade six child will thus yield many more usable words at his disposal. In fact, the authoritative Kanghsi dictionary lists about 42,000 to 48,000 characters, depending on the editions referred to, with about 6,000 to 7,000 characters as being actively used. This corpus of active and latent characters may be compared with Oldfield's (1963) estimate of 75,000 entries as the size of the literate (British) adult.

The noted linguist and sinologist Chao (1968) lists some ten criteria for a good symbol system and concludes that Chinese does not rank very high on these requirements except in "elegance". This refers to the symmetry of the symbols and the information value per chunk (see Figure 1). As an orthography, Chinese has shown stability over geographical space and historical time as it has served well the Chinese and related language communities (e.g. the Japanese and the Koreans) over thousands of years. The stability reflects much slower structural changes and less susceptibility to dialectical variations than the alphabetic system. The eminent linguist Halle (1969) makes a rare slip when he refers to the arbitrary symbols of Chinese and rote memory needed in memorizing these characters. The present writer has attempted to dispel this myth and show how the radicals and phonetics composing a character constitute the critical units and resemble morphophonemics in English (Leong, 1973). When the linguist Wang (1973) claims that Chinese "is not conspicuously complex" and that "it is simpler than the western languages" (p.51), he likewise refers to Chao's criterion

of elegance and information value of the characters.

The Word

Even though we read in sentences and connected prose with words embedded in context, psychological experiments have shown the value of studying the word and its relation to reading.

In English, a word is usually defined as a morpheme or a combination of morphemes, although meaning can be conveyed in other ways. A word is also defined as a unit of syntax. Operationally, a word is a graphic unit separated by visual spaces with orthographic constraints and intra-word redundancies. In Chinese, a word is less easily defined. An individual graphic symbol or character tzù (字 [tsz] unaspirated, falling tone) is at best the sociological equivalent of a word. It is interesting to note that the sinologist Soothill (1942) deliberately left untranslated in his 1899 dictionary The Student's Four Thousand 字 , which some authors correctly translated as Four Thousand [Characters], while not a few librarians thought " 字 " in the title was a decoration and left it out in the catalogue altogether! Strictly, a character as the smallest functional unit is a morpheme and corresponds to the syllable in English (Chao, 1968; Kratochvil, 1968; Leong, 1973; Wang, 1973). Wang (1971) further notes that the number of strokes (see Figure 1 for illustration of order and geometric position of strokes) in a character approximates the number of letters in an English word and that there is a "parallelism in information content between the stroke and the letter". Moreover, the complexity of a character in terms of the number of strokes bears little relationship to the ease or difficulty

in reading or spelling. Leong (1972, 1973) has found from a count of 1851 commonly used characters that the average stroke number is 11.27 and this compares with the mean of 11.61 with another list of 2830 characters. There is no evidence from his empirical studies that "simple" characters in terms of number of strokes are easier to learn. The syntactic word in Chinese is t z'ʻ (詞 [t s'ʻz] aspirated high-falling tone), which is the smallest immediate constituent unit of segmental sentences. The equivalent of the English word "middle" is composed of two characters (see Figure 1) and it should be noted that strings of characters are not separated by visual spaces except at the end of a sentence.

Reference has been made to the role of critical features and the phonological representation in perceiving words. If it is phonemic discrimination which is important to the beginning reader in English, it is tonemic discrimination to the child learning to read in Chinese. A tone is primarily the pitch pattern of the vocalic nucleus of a syllable, which is traditionally divided into an "initial" and a "final". If the initial is voiced, the tone begins with the initial and spreads over the whole syllable. If the initial is voiceless, the tone is spread over the final only. In the national language (Mandarin) there are four tones: high level (平), high rising (上), low rising (去), low falling (入). A change in tone alters the meaning of a symbol just as a change in a phoneme would alter the meaning in English. The tone change is illustrated in the schematic oscillographic tracing in Figure 2. It should also be noted that the Chinese language has a large

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Insert Figure 2 about here

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number of vowel sounds and a small number of consonant sounds. The dominant pattern is for one consonant at the beginning of a vowel, except for fricatives (/ts/, /dz/, /ch/, /dj/), which are regarded as single sounds. The final consonants /n/, /ŋ/, /m/, /p/, /t/, /k/ are truncated. Thus, every character or syllable must have a vowel sound or a semi-vowel sound of /n/, /ŋ/, or /m/ but only about two consonant sounds. The dominance of vowel over consonant sounds leads to a large number of homophones, which are distinguished one from the other by the system of tone changes explained above. Chao (1968) has commented that on the whole there is "probably no more ambiguity in spoken Chinese than in most other languages spoken" (p.75).

The Sentence

Perceiving a word also implies knowing the construction into which the word can enter when words are arranged in sequence to form a sentence. One way to explain a sentence is that it is a free form bounded by pauses at both ends. Some linguists find it useful to use the term "utterance" for an instance of occurrence of a sentence, as significant prosodic elements (pitch, stress, juncture) often affect meaning. An example is: "They <u>are</u> (,) starving children" compared with "<u>They</u> (,) are starving children". Linguistic awareness underpinning reading refers to both syntactical and semantic knowledge in addition to phonological

representation . This is clear from the above pair of sentences. The oft-quoted example of "colorless green ideas sleep furiously" further illustrates this relationship. Phonologically and syntactically the sentence is well-formed. Semantically, it is ill-formed as it is devoid of meaning. The ambiguous sentence "The girl looked up the road" further explains the need to understand surface and deep structures. The two ways of grouping the sentence to resolve the ambiguity are:

(a) The girl (looked (up the road)).

(b) The girl ((looked up) the road).

A parallel example in Chinese is the two renderings of the same strings of characters:

(a) Ta tzoou (,) bu hao. 他走(,)不好。

(That he goes is not good - he had better not go).

(b) Ta tzoou bu-hao. 他走不好。

(He cannot walk well).

The full tone on bu (buh) and the optional pause between "Ta tzoou" and "bu hao" in sentence (a) make it a different sentence from sentence (b) in which "tzoou - bu - hao" is one word with no break. A similar example is the doggerel when different junctures make for different meaning:

(a) 落雨天留客 (,) 天留我不留 。

(literal translation - Rainy day retains guest, day (the elements) retains (guest) but I do not retain (guest)).

(b) 落雨天 (,) 留客天 (,) 留我不 (,) 留 。

(literal translation - Rainy day, day to retain guest; retain me not?

retain.)

According to (a) the guest is unwelcome to stay even though it rains; according to (b) a rainy day is just the day to stay! It is thus clear that when the suprasegmental phonemes (including tones) and the prosodic elements are all specified, they help to determine the meaning of a sentence, be it in English or Chinese.

There are, however, some differences in processing sentences in different writing systems. The importance of the potential pause between subject and predicate is reflected in the Chinese usage with regard to punctuation. With the literary style of writing it is the practice to pause after about four syllables even though there is no punctuation. An example from the classics is:

大學之道(,)在明明德.。

(Free translation - "The way of the great learning (S - Subject), lies in illuminating the illustrious virtues (P - Predicate).") This is in contrast to written English where a subject and a verb are never separated by punctuation.

Another difference is the limited or optional use of auxiliaries in the Chinese sentence. In the Chinese equivalent of the English sentence "His mother spanked him last week" the phrase "spanked him" can be expressed either as "ta - liao t^{h}a" (打了他) or "ta t^{h}a" (打他). More often than not, the presence of auxiliaries is due to rhythmic reasons. Equally puzzling to the beginning reader is the maintenance in interrogative sentences of the same word - order as in declarative sentences. The question "Does he come?" where word order is

inverted for interrogation can be rendered as "T'a lai pu lai." ("He come(s) not come(s)" or "He comes; he comes not"), or "Tā lai mā?" ("He come(s)?"). In the former sentence the speaker posits the possible alternatives.

"Linguistic Awareness" and Learning to Read

That different writing systems constrain the reading process differentially can be expected (Gillooly, 1973). The question is at what level and to what extent does the beginning reader recode the requisite phonological, syntactical and semantic representation from the alphabetic or morphemic script. This recoding in English goes far beyond the one-to-one grapheme - phoneme correspondence, as would be the case with Morse code ciphers. Chomsky (1970) dismisses this simplistic correspondence as "something of a pseudo issue" (p.15) and goes on to say:

> What the beginning reader must learn (apart from true exceptions) is simply the elementary correspondence between the underlying segments of his internalized lexicon and the orthographic symbols. (p.16)

This lexical representation refers to the deeper level and the more complicated relationship than that afforded by the auditory matching of one symbol and one sound. An example is the differential realization of "courage" which is phonetically [kʌ'rəǰ] in isolation and [kərēyǰ] in the context of "courageous". The vowel reduction to a neutral schwa [ə] is brought about in both renderings by contextual changes and stress shift. The child who distinguishes the two renderings and reads them correctly needs to:

(a) respond to the root or lexicon unit of Koræge,

(b) modify the pronunciation according to phonological principles and

(c) respond to or modify the phonological principles by his understanding of syntactical rules and the addition of graphemes (e.g. a suffix) to the lexical form.

The English orthography thus preserves the similarity of meaning and signals different usage (and sound) in a way far beyond the simple one-to-one mapping. Decrying the over-emphasis of teaching one-to-one phonic correspondence such as teaching "bat" as "b-a-t, buh-ah-tuh, say-it-very-fast, bat" Smith (1973, p.89) even goes so far as to say that phonics will provide only "a clue to the sound (or "name") of a configuration being examined. Phonics can provide only approximations."

That the one-to-one letter-to-sound correspondence in English is not adequate to explain initial reading and that the representation of deeper phonological, syntactical and semantic system is essential are emphasized by various workers. These include linguists as C. Chomsky (1970), N. Chomsky (1970); psycholinguistic empiricist as Venezky (1967, 1970); cognitive psychologists as Gibson (1970a, 1970b) and her Cornell group (Gibson and Levin, 1975); and experimental psychologists at the Haskins Laboratories as Cooper (1972), A Liberman, Cooper, Shankweiler, and Studdert-Kennedy (1967), I.Liberman (1971), Mattingly (1972), Shankweiler and Liberman (1972, in press). This latter group, while accepting the psychological realities of the phoneme, has demonstrated that consonants and vowels are not discrete entities in the signal,

but are encoded as one overlapping acoustic segment. (Liberman, 1970). Figure 3 shows the temporal overlapping of initial and final consonants and the all pervasive influence of the vowel. There is no place to dissect the syllable "bag" into the usual portions (as taught in schools) of [b], [æ] and [g]. The continuous restructuring of the message shows phonemes such as /b/ or /g/ cannot be isolated but are recognizable only in an acoustic environment. The temporal telescoping of the phonetic string into syllables can be extended into a comparable collapsing of the deep structure into surface structure as represented schematically in Figure 4.

Insert Figures 3 and 4 about here

It is from such ongoing theoretical and empirical studies in psychoacoustics that recently Gleitman and Rozin (1973) advocated the use of the syllable as a unit for initial acquisition of reading. This position has drawn some rather intemperate remarks about the "silly syllables", as "not the units of language" in a critique from Goodman (1973). Granted that the Rozin, Poritsky, and Sotsky (1971) experiment showing the successful use of the syllabary with inner-city school children suffers from some methodological weaknesses and that the Gleitman and Rozin recommendation of the rebus (with pictures representing concrete words) as a "syllabic curriculum" has limited usefulness and poses other theoretical problems, the fact remains that

individual phonemes are only realized in the context of acoustic environment and that segmentation into phonemes by young children is difficult. Segmentation into syllables is posited as an alternative in the learning to read process. In his admonition of Gleitman and Rozin, Goodman overlooks these researchers' important qualification, in a footnote, of the role of the syllable as "neither where the child begins, nor is it where one would want him to end up, in reading; words and phrases are the units with which the child begins ..." (Gleitman and Rozin, 1973, p. 463) and the authors' emphasis on the acquisition of phonological principles. Goodman is right in pointing out that syllabification has its inherent difficulties. For one thing, over-emphasis on syllabification goes against the principle of economy of the English alphabet as there are many more syllables than there are letters of the alphabet and phonemes. For another, syllabification is not simply going by "what the sound says" in hyphenation with such results as "drummer" hyphenated wrongly into "drum-mer" where it should have been "drumm-er". Shuy (1969) outlines some "semi-ordered syllabication rules" - lexical, grammatical and phonological - to highlight difficulties in defining limits of a syllable.

It should be noted that in speaking of phonological features Jakobson and Halle (1971) seem to be emphasizing the syllable as well:

> The distinctive features are aligned into simultaneous bundles called phonemes; phonemes are concatenated into sequences; the elementary pattern underlying any grouping of phonemes is the syllable. (p. 31)

It is clear that the perception of language (as well as its production)

depends on the understanding of distinctive features in phonemes and the concatenation of phonemes into larger clusters such as the syllable. Learning to read builds on a phonetic base. The emphasis of such writers as Goodman (1969) and Smith (1971) on meaning almost to the neglect of the link between reading and speech applies more to mature, fluent reading rather than to initial reading. Interestingly enough, when Smith (1975) states that "the English spelling system indicates how words are related in meaning independently of their sound" (p. 351, see also p. 350) he can be presumed to be referring to the Chinese orthography. Mention has been made of individual Chinese characters being equated with syllables and strokes within characters with letters of the alphabet. In so far as each character is learnt as a "whole" the correspondence to a syllable is evident. The present writer has shown (Leong, 1973) that there are invariant spelling-to-morpheme or even to sound units within each character. The phonetic giving the sound equivalent and the radical giving the meaning of a character constitute the phonemic-semantic constituent so critical to learning to read. An example is the character 染 "dye" which has a sound component not far removed from 丸 "pellet" (hence the common mispelling of 染). Morphologically 染 is composed of 氵 "water", 丸 "nine" (times), 木 "wood" (a dye stuff in olden days); hence the meaning of the character as a whole. The distinctive properties of the radicals and phonetics in Chinese might be compared with letter groupings in the English morpho-phonemics. The important point is that understanding of intraword morphemic elements helps beginning reading. This, in the last analysis,

is a cognitive process requiring the use of efficient rules and strategies in encoding symbols (see Leong, 1975, in press).

In learning to read, the problem of finding the best segment, be it a phoneme, a syllable, a word or a phrase cannot be answered without knowing the nature of the task and the linguistic awareness of the beginning reader. Gibson and Levin (1975) are emphatic:

> A multilevel approach is essential. What the child reads must make sense. At the same time, it must not be so hard that he fails. Whatever the segment, it must be the most economical one that he is capable of processing. (p.289)

It is of more than academic interest to explore Luria's (1966, p. 411) claim that "the different bases for writing in different languages must entail a different cortical organization". Clinical studies of aphasic Japanese patients with and without apraxia of speech (Sasanuma and Fujimura, 1971, 1972) seem to show that the Chinese character or Kanji component and the syllabary or hiragana component of Japanese are processed differently in the neural mechanisms. The Kana transcription seems to relate to the "phonological processor" in the brain while the Kanji transcription could bypass such processing. If this is substantiated, the role of the auditory short-term store, so important in learning English, will be a diminished one in learning Chinese. Empirical studies with Kanji by the Haskins group (Erickson, Mattingly, and Turvey, 1972) and their ongoing research into the relationship between reading and speech (Shankweiler and Liberman, in press) point to the importance of the auditory short-term store as "necessary to primary linguistic activity" and that morphological information may

require phonetic storage at an intermediate stage of processing. The Sasanuma and Fujimura results are interpreted not as independent neural processing of the alphabetic and morphemic components, but as differential realization of linguistic awareness.

Summary

In learning to read, English is largely learnt by eye and by ear and Chinese by eye and by hand. As a symbol system English is more efficient for information processing with graphemic units related to underlying phonological representation via morphophonemics. As an orthography, Chinese provides more information per chunk and is less susceptible to dialectical variations. The processing of words in English and Chinese is compared. Similarities and differences in processing sentences in the two systems are outlined. All beginning readers must learn correspondence between critical features and underlying lexical representation. Segmentation into phonemes and into syllables and its bearing on beginning reading is discussed. At the neural level it is likely a morphemic system still requires phonetic storage at an intermediate stage of processing. Whatever the writing system, efficient strategies and rules in linking script and the underlying phonological, syntactical and semantic representation are important.

References

Chao, Y. R. Language and symbolic systems. Cambridge: Cambridge University Press, 1968.

Chomsky, C. Reading, writing, and phonology. Harvard Educational Review, 1970, 40, 2, 287-309.

Chomsky, N. Phonology and reading. In H. Levin & J. P. Williams. (Eds.), Basic studies on reading. New York: Basic Books, 1970.

Cooper, F. S. How is language conveyed by speech? In J. F. Kavanagh & I. G. Mattingly (Eds.), Language by ear and by eye. Cambridge, Mass.: The MIT Press, 1972.

Erickson, D., Mattingly, I. G., & Turvey, M. T. Phonetic activity in reading: An experiment with Kanji. Haskins Laboratories Status Report on Speech Research SR-33, 1972, 137-156.

Gibson, E. J. Learning to read. In H. Singer & R. B. Ruddell (Eds.), Theoretical models and processes of reading. Newark, Delaware: International Reading Association, 1970. (a)

Gibson, E. J. Ontogeny of reading. American Psychologist, 1970, 25, 2, 136-143. (b)

Gibson, E. J. & Levin, H. The psychology of reading. Cambridge, Mass.: The MIT Press, 1975.

Gillooly, W. B. The influence of writing-system characteristics on learning to read. Reading Research Quarterly, 1973, 8, 2, 167-199.

Gleitman, L. R. & Rozin, P. Teaching reading by use of a syllabary. Reading Research Quarterly, 1973, 8, 4, 447-483.

Goodman, K. S. Words and morphemes in reading. In K. S. Goodman & J. T. Fleming (Eds.), Psycholinguistics and the teaching of reading. Newark, Delaware: International Reading Association, 1969.

Goodman, K. S. The 13th easy way to make learning to read difficult: A reaction to Gleitman and Rozin. Reading Research Quarterly, 1973, 8, 4, 484-493.

Halle, M. Some thoughts on spelling. In K. S. Goodman & J. T. Fleming (Eds.), Psycholinguistics and the teaching of reading. Newark, Delaware: International Reading Association, 1969.

Huey, E. B. The psychology and pedagogy of reading. New York: Macmillan, 1908.

Jakobson, R. & Halle, M. Fundamentals of language. The Hague: Mouton, 1971.

Karlgren, B. Sound and symbol in Chinese (Rev. ed.) Hong Kong: Hong Kong University Press, 1962.

Kavanagh, J. F. (Ed.), Communicating by language: the reading process. Bethesda, Md.: U.S. Department of Health, Education, and Welfare, National Institutes of Health, Government Printing Office, 1968.

Kavanagh, J. F. & Mattingly, I. G. (Eds.), Language by ear and by eye: the relationships between speech and reading. Cambridge, Mass.: The MIT Press, 1972.

Kratochvil, P. The Chinese language today. London: Hutchinson University Library, 1968.

Leong, C. K. A study of written Chinese vocabulary. The Modern Language Journal, 1972, 56, 4, 230-234.

Leong, C. K. Hong Kong. In J. Downing (Ed.), Comparative reading: Cross-national studies of behavior and processes in reading and writing. New York: Macmillan, 1973.

Leong, C. K. Dichotic listening with related tasks for dyslexics -- differential use of strategies. Bulletin of the Orton Society, 1975, 25, 111-126.

Leong, C. K. Lateralization in severely disabled readers in relation to functional cerebral development and syntheses of information. In R. M. Knights & D. J. Bakker (Eds.), The neuropsychology of learning disorders: theoretical approaches. Baltimore: University Park Press. (in press)

Liberman, A. M. The grammar of speech and language. Cognitive Psychology, 1970, 1, 301-323.

Liberman, A. M., Cooper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. Perception of the speech code. Psychological Review, 1967, 74, 6, 431-461.

Liberman, I. Y. Speech and lateralization of language. Bulletin of the Orton Society, 1971, 21, 71-86.

Luria, A. R. Higher cortical functions in man. New York: Basic Books, 1966.

Mattingly, I. G. Reading, the linguistic process, and linguistic awareness. In J. F. Kavanagh & I. G. Mattingly (Eds.), Language by ear and by eye: The relationships between speech and reading. Cambridge, Mass.: The MIT Press, 1972.

Oldfield, R. C. Individual vocabulary and semantic currency. British Journal of Social and Clinical Psychology, 1963, 2, 122-130.

Rozin, P., Poritsky, S., & Sotsky, R. American children with reading problems can easily learn to read English represented by Chinese characters. Science, 1971, 171, 1264-1267.

Sasanuma, S. & Fujimura, O. Selective impairment of phonetic and non-phonetic transcription of words in Japanese aphasic patients: Kana vs. Kanji in visual recognition and writing. Cortex, 1971, 7, 1, 1-18.

Sasanuma, S. & Fujimura, O. An analysis of writing errors in Japanese aphasic patients: Kanji vs. Kana words. Cortex, 1972, 8, 3, 265-282.

Shankweiler, D. P. & Liberman, I. Y. Misreading: A search for causes. In J. F. Kavanagh & I. G. Mattingly (Eds.), Language by ear and by eye: the ralationships between speech and reading. Cambridge, Mass.: The MIT Press, 1972.

Shankweiler, D. P. & Liberman, I. Y. Exploring the relations between reading and speech. In R. M. Knights & D. J. Bakker (Eds.), The neuropsychology of learning disorders: theoretical approaches. Baltimore: University Park Press. (in press)

Shannon, C. E. Prediction and entropy of printed English. Bell Systems Technical Journal, 1951, 30, 50-64.

Shuy, R. W. Some language and cultural differences in a theory of reading. In K. S. Goodman & J. T. Fleming (Eds.), Psycholinguistics and the teaching of reading. Newark, Delaware: International Reading Association, 1969.

Smith, F. Understanding reading. New York: Holt, Rinehart & Winston, 1971.

Smith, F. Psycholinguistics and reading. New York: Holt, Rinehart & Winston, 1973.

Smith, F. The relation between spoken and written language. In E. H. Lenneberg & E. Lenneberg (Eds.), Foundations of language development: A multidisciplinary approach (Vol. 2). New York: Academic Press, 1975.

Soothill, W. E. The student's four thousand 字 and general pocket dictionary. London: Kegan Paul, 1942. (Originally published, 1899.)

Venezky, R. L. English orthography: Its graphic structure and its relation to sound. Reading Research Quarterly, 1967, 2, 75-106.

Venezky, R. L. Regularity in reading and spelling. In H. Levin & J. P. Williams (Eds.), Basic studies on reading. New York: Basic Books, 1970.

Wang, W. S-Y. Review of Lin: Chinese characters and their impact on other languages of East Asia. The Modern Language Journal, 1971, 15, 187-188.

Wang, W. S-Y. The Chinese language. Scientific American, 1973, 228, 2, 51-60.

Figure Caption

Figure 1. Illustration of an orthography best learnt by eye and hand -- Chinese. Reading is from right to left, top to bottom. Note the symmetry and rhythm of the characters. Those enclosed in dotted lines also show the flow of the strokes.

Figure 2. Illustration of tone changes in Chinese with schematic oscillographic tracing.

Figure 3. Schematic spectrogram showing parallel transmission of phonetic segments after encoding to the level of sound (after Liberman, 1970.)

Figure 4. Schematic representation showing parallel transmission of deep structure segments after encoding to the level of surface structure (after Liberman, 1970).

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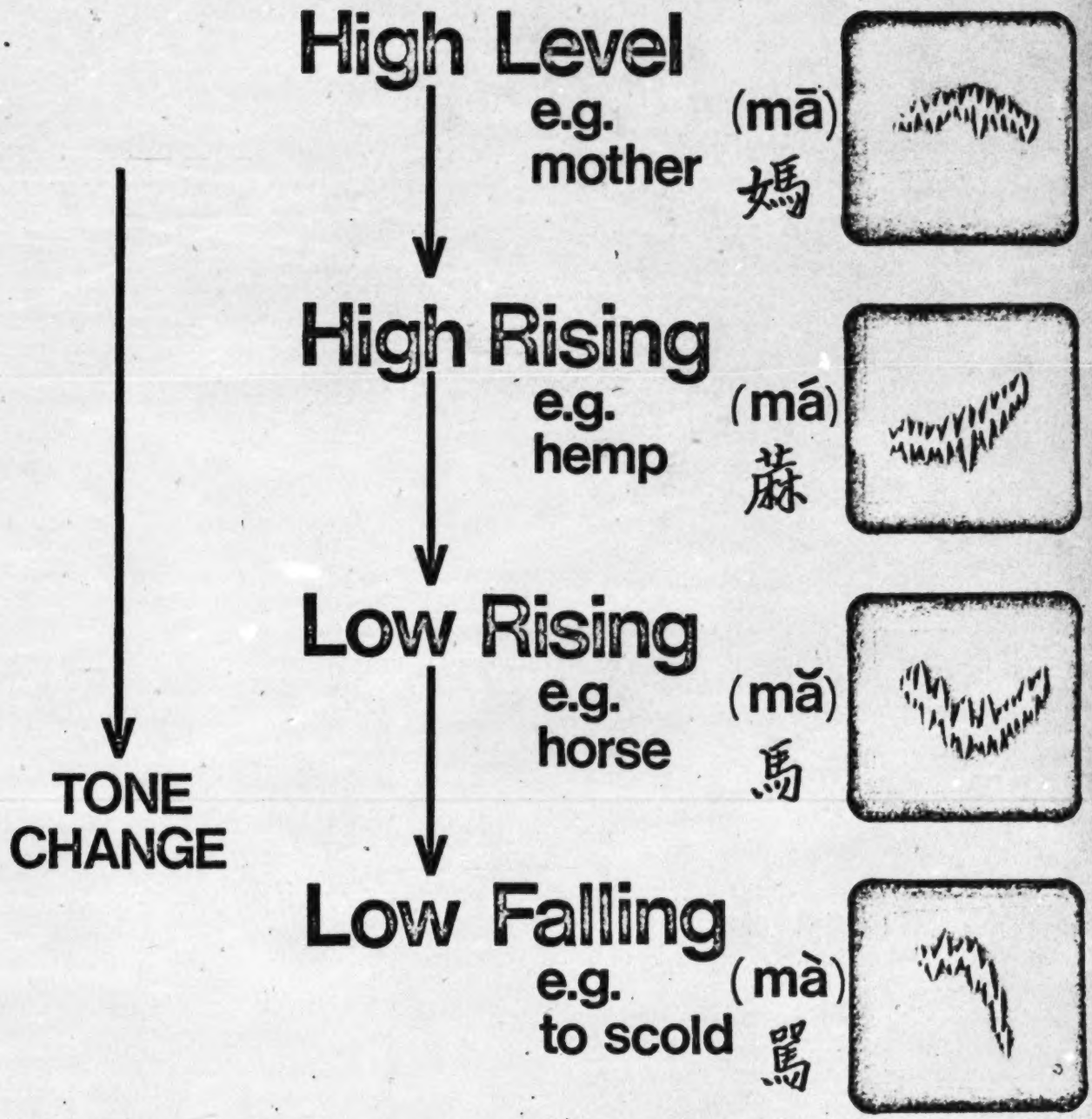

FIG. 2. Illustration of tone changes in Chinese with schematic oscillographic tracing.

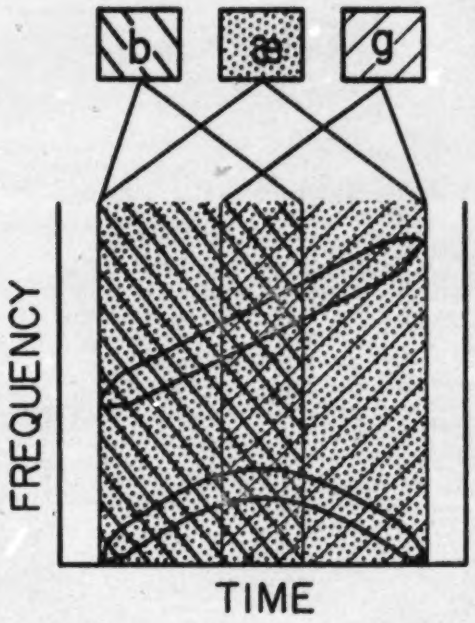

Figure 3. Schematic spectrogram showing parallel transmission of phonetic segments after encoding to the level of sound (after Liberman, 1970).

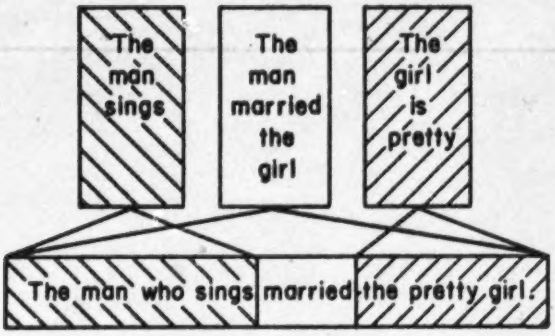

Figure 4. Schematic representation showing parallel transmission of deep structure segments after encoding to the level of surface structure (after Liberman, 1970).